importance (an exaggerated importance according to Marignac's criticism) to an interesting observation made by Prof. Nordenskiöld, who had announced (*Comptes rendus*, ciii. (1886), 795) the fact that the crude mixture of yttria earths, as precipitated from different minerals, although really a compound body, has nevertheless always a constant molecular weight, whatever may be the mineral from which it is extracted. To this mixture of earths, which thus behaves like an element, Prof. Nordenskiöld gave the name gadolinia, or oxide of gadolinium. In a subsequent paper (*Öfversigt af Vetenskaps-Akademiens Förhandlingar*, 1887, No. 7) in answer to the criticisms of Marignac and Rammelsberg, he showed that although the molecular weights for the individual earths which make up gadolinia vary between 136 and 394, yet the molecular weight for the mixture as a whole, obtained from a number of different minerals from various localities, only varied from 258 to 271.

The work of which an account is given in the paper now before us was undertaken in order to discover whether the above slight differences were only dependent on variations in the experimental methods. The author has not attempted to make any separation of the individual earths, but has confined himself to further determinations of the molecular weight of the group as a whole. The result of fifty-four determinations made upon such minerals as gadolinite, orthite, samarskite, monazite, &c., from various localities was to show that gadolinia from widely different sources has a molecular weight ranging from 247·9 to 275·8. The gadolinia used in these determinations was obtained by first separating the cerium metals by precipitation with potassium sulphate, precipitating the filtrate with ammonia, dissolving this precipitate, and reprecipitating with oxalic acid. Care was taken to avoid any fractionation which might occur, but any fear on this account was discounted by the unexpected discovery made during the course of the work that any gadolinia fractioned out (*e.g.* thrown down with the cerium oxides in the K_2SO_4 precipitate) had a molecular weight differing only very slightly from that of the rest of the earth.

The criticism which the author next applies to eighty-one molecular weight determinations made by Blomstrand, Engström, Rammelsberg, and others, leads to the rejection of forty, either owing to the small amount or to the impurity of the material used. The numbers in the case of the forty-one determinations retained fall within the limits obtained by the author.

Now, the molecular weights of the twelve earths which are at present stated to enter into the composition of gadolinia range from that of scandia, 136, and yttria, 227, to that of ytterbia, 394; so that the fact that, in spite of this wide divergence in the molecular weights of the constituents, the molecular weight of gadolinia itself only varies by at most 5·4 per cent. from the mean value, 262, is sufficiently startling. Thus no gadolinia has yet been found containing exclusively one only of these individual earths. The author shows, by a review of other minerals containing isomorphous groups of elements, how distinct in this respect is the behaviour of this group of yttria earths.

We have seen what use Crookes has made of these curious facts. We will conclude, therefore, by giving Marignac's conclusions on the same subject, as contained in his criticism of the author's previous paper. He is of opinion that all that can be affirmed is that yttria is always met with in nature mixed with a variable number of analogous and isomorphous earths *of much higher molecular weight*, and that it is always the dominating element in this mixture. G. T. P.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, December 18, 1891.—Prof. W. E. Ayrton, F.R.S., President, in the chair.—The President announced that it had been found necessary to alter the dates of the meetings to be held after Christmas from those already published to the following: January 22, February 12 and 26, March 11 and 25, April 8, May 13 and 27, June 10 and 24.—A note on interference with alternating currents was communicated by Mr. M. H. Kilgour. Whilst studying Dr. Fleming's paper on some effects of alternate current flow in circuits having capacity and self-induction, the author constructed some additional curves. He was thereby led to investigate whether the serious rises of pressure produced by adding capacity would occur over considerable ranges of capacity, or whether they would only take place when the capacity was nearly equal to a particular value. Taking the case of a condenser of capacity C farads, in series with a circuit of resistance R ohms, and inductance L henrys, he showed that the maximum value of λ (the ratio of the pressure across the condenser terminals to that across the condenser and inductive resistance) is obtained when

$$C = \frac{L}{R^2 + p^2L^2}, \quad . \; . \; . \; . \; . \; . \; . \; . \; (1)$$

where $p = 2\pi$ times the frequency. The maximum value of λ produced by this capacity being given by the expression

$$\Lambda = \frac{\sqrt{R^2 + p^2L^2}}{R}. \quad . \; . \; . \; . \; . \; . \; . \; (2)$$

Taking $R = 10$, and $p = 2\pi \,.\, 1000$, curves plotted from equations (1) and (2) between C and L, and between Λ and L had been drawn. The CL curve rises to a very sharp peak at $L = 0{\cdot}0015$, and falls rapidly. That between Λ and L starts horizontal and bends upwards, and approximates to an inclined straight line for values of L greater than 0·002; when $L = 0{\cdot}1$, $\Lambda = 63$. Considering the question of the range of capacity with which a given rise of pressure can occur, it was pointed out that when the values of L, R, and p are such as to make a large rise possible, a rise exceeding a moderate value can only be obtained for values of C differing little from that given by equation (1). On the other hand, when the circuit is such that the maximum rise possible is not large, then a rise exceeding a given moderate value can be obtained over a much wider range of capacity. Hence the author concludes that the larger the possible rise the smaller is the probability of a serious rise occurring. The effect of shunting the condenser by a circuit of resistance r and inductance l is next dealt with in the paper, and the values of C which make λ a maximum determined, as well as the maximum value L can have. Subsequently the author examines whether the practical case of an alternator feeding a transformer through a concentric cable may be simplified without introducing serious error by assuming the capacity concentrated at either end of the cable, and concludes that in ordinary cases little error will be thus made. In an experiment made with a 100 kilowatt alternator, $\frac{3}{4}$ mile of $\frac{37}{15}$ concentric cable, and an 18 kilowatt transformer, a rise of $\frac{1}{4}$ per cent. was found to occur at the terminals of the alternator when the cable was connected. Putting on the transformer unloaded or loaded with but a dozen 16 candle-power lamps produced little change in the rise of pressure, this in all cases being between 0·2 and 0·3 per cent. Dr. Sumpner asked whether the conclusions as to the range of capacity with which a given rise of pressure was possible, were true for small rises such as occur in practice. Cases where the maximum possible rise was of the order 63 were not likely to occur at ordinary frequencies. The highest rise he had ever known was 11. He thought the time-constant of the inductive coil chosen—viz. $\frac{1}{100}$ of a second—was very large. In circuits containing iron it was practically impossible to get such large time-constants, for the power spent in the iron increased the effective resistance. Referring to the narrow range of capacity within which large rises were possible, he pointed out that such cases were found in Hertz's resonators, where the rises were immense, but to obtain them the adjustments had to be very accurately made. Dr. S. P. Thompson said he regretted that Prof. Fleming was not present, for he had recently investigated Hertz's experiments, and had obtained curves very similar to those got for the Deptford mains. The curve between Λ and L was very interesting. It was, in fact, a curve between the secant of the angle of lag and L, as could be seen from formula (2). In practice one would be working on the lower portion, and hence the rises would be small. Mr. Kilgour explained that in the paper his first object was to show that the product of the ange of capacity between which a rise greater than a given value would occur and the maximum possible rise was approximately constant for different circuits. Secondly, he wished to prove that the capacity of concentric cables could be assumed to be localized at either end without introducing much error in the rises of pressure calculated therefrom. Dr. Thompson, speaking of nomenclature, regretted that the word inductance should be used sometimes for L and at other times for Lp, and thought its meaning should be restricted to the latter. Prof. Perry said a name was needed for coefficient of self-induction. Resistance was practically independent of frequency, and "inductance" should have no reference to frequency. Dr. Sumpner thought it important to have a name for Lp, for that quantity comes into calculations most frequently. He would have preferred that "inductance" should mean Lp, but Mr. O. Heaviside, who introduced the term, had used it for L. The President remarked that some time ago Dr. Sumpner and himself felt the need of a name for Lp, and thought of using "inductance," but on referring to Mr. Heaviside's articles found it used for L. Dr. C. V. Burton asked whether the word "self-induction" could not be used as an abbreviation for "coefficient of self-induction." Dr. Thompson pointed out that this word already had a meaning, viz. L multiplied by current. Dr. Burton then suggested that inductivity might be applicable. Dr. Thompson said the word "impedance" was also used ambiguously, for the sense in which Dr. Lodge uses it in his "Modern Views of Electricity" is not the same as the vector sum of R and Lp. Prof. Perry recalled the fact that "impedance" had been defined by the Committee of the British Association as the ratio $\frac{\text{effective voltage}}{\text{effective current}}$. Dr. Thompson said this definition was only applicable to periodic currents, and not to intermittent or transient ones. The President said he understood the first object of Mr. Kilgour's paper was to inquire whether the dread of rise of voltage occurring when concentric mains were used need exist. When Dr Fleming's paper was read, the general idea was that concentric cables were dangerous. In the discussion on it, he, amongst others, had pointed out that the chance of a large rise of pressure was not a serious one. Mr. Kilgour had now shown that the range of capacity over which a particular rise could occur is inversely proportional to the maximum rise possible in the particular circuit. When the circuit was such that a large rise was possible, the probability of any serious rise taking place was very small, hence the fears of large rises were more or less unfounded. The second part of the paper was to show that ordinary problems on concentric cables could, in practice, be treated with sufficient accuracy by assuming the capacity localized at either end of the cable, instead of distributed along its length.

Royal Microscopical Society, December 16, 1891.—Dr. R. Braithwaite, President, in the chair.—Mr. E. M. Nelson said he had severely tested Messrs. Powell and Lealand's new apochromatic $\frac{1}{12}$ of 1·4 N.A. both visually and photographically, and he could say it was of remarkably fine glass. It gave an image more free of colour than that of many apochromatics he had seen; its speed in microphotography was very great. He noted it was fitted with a correction collar.—Mr. H. Bernard exhibited and described a new form of mechanical stage which he had invented; it was specially designed to obviate the inconvenience arising on account of the very limited range of motion admitted by those at present in use. The plan which he had tried to follow was to imitate the movement of the fingers as they are used for moving glass slides under the microscope. The mechanism was all under and at the side of the stage. Slides were moved by light adjustable frames. In this way a movement of 10 cm. by 5 cm. was speedily obtained without jarring against the condenser, or interfering with the light. Large slips with series of sections could thus be very easily examined, and zoophyte troughs could be searched from corner to corner. By placing a brass plate on the movable frame it was shown that the contents of a watch-glass could be closely examined, the movement avoiding the usual shaking of the fluid caused when watch-glasses are manipulated by the fingers. He had shown the original drawings of the stage to Prof. Abbe, who thought the idea was so good that he had had the stage exhibited made by the firm of Zeiss. The President, in thanking Mr. Bernard for bringing this stage to their notice, expressed the opinion that it was likely to be found most useful for dissecting purposes. He had often felt the inconvenience arising from the want of a greater range of movement in the ordinary mechanical stage. After the business of the meeting was over, Mr. Bernard gave a demonstration to the Fellows, and very favourable comments were passed on its practical use and originality.—Prof. J. W. Groves read a letter from Mr. Hermann giving information that *Volvox globator* was to be found in great abundance in a pond in the neighbourhood of Balham.—A paper on the resolution of *Podura*, by the Hon. J. G. P. Vereker, was read by Prof. Groves. The author stated that he had been experimenting in photomicrography on some scales of *Podura*, and had obtained results which he thought threw some light upon their structure. The photomicrographs exhibited he considered appeared to prove that the *Podura* scale consists of a hyaline beaded membrane, having minute featherlets inserted in it. At the broadest part of the scale there are one or two rows of beads between the featherlets, while towards the base and top of the scale the beads tend to form single rows. Mr. E. M. Nelson believed that the effects were due to the thickening of the membrane. Mr. J. E. Ingpen said that Mr. Wenham had gone into this subject, and he had come to the conclusion that the markings were inflations of the membrane.—The President reminded the Fellows that the next meeting would be the anniversary, and that it would therefore be necessary to appoint two auditors to examine the treasurer's accounts; on behalf of the Council he had appointed Mr. W. T. Suffolk. Mr. Nelson proposed, and Mr. Wynne E. Baxter seconded, Mr. J. M. Allen as auditor on the part of the Fellows. This was put to the meeting and unanimously carried.

EDINBURGH.

Royal Society, December 21, 1891.—Dr. William Craig in the chair.—Prof. Crum Brown communicated an obituary notice of the late Mr. Andrew Young, by the Rev. Prof. Flint.—Prof. Crum Brown also read a preliminary communication, by Dr. Dawson Turner, on the electric resistance of various urines. The electric resistance is found to vary markedly when the proportion of solid constituents in solution is different. This test promises to be of use to the medical practitioner. Kohlrausch's method of determining the resistance by alternating currents and the telephone was adopted.—Mr. Malcolm Laurie read a paper on some Eurypterid remains from the Upper Silurian deposits of the Pentland Hills. This collection of fossils is now in the Edinburgh Museum of Science and Art, and contains a number of new forms, one of which has been made the type of a new genus—*Drepanopterus*. This form is characterized by great breadth of carapace, and by the shape of the single limb which is preserved. The limb is long and narrow, and ends in a slightly expanded sickle-shaped segment. The genus appears to occupy a position intermediate between *Eurypterus* and *Stylonurus*. Among the other remains are found two new species of *Stylonurus*—*S. ornatus* and *S. macrophthalmus*. Two new species of *Eurypterus* are also represented—*E. conicus* and *E. cyclophthalmus*. The second species of Stylonurus and both species of Eurypterus are characterized by exceptionally large eyes.—Prof. Cossar Ewart read the second part of a paper, written by himself and Mr. J. C. Mitchell, on the lateral sense-organs of Elasmobranchs. In this part the authors dealt with the sensory canals in *Raia batis*. It has been supposed that these canals serve for the production of mucus. The authors consider that this idea must be abandoned. They have observed a number of mucus glands in the skin sufficient to account for all the mucus found on the surface. They incline to the opinion that the canals have some respiratory function.

PARIS.

Academy of Sciences, December 28, 1891.—M. Duchartre in the chair.—On a telescope *reseau*, by M. Mascart.—Note, by M. Faye, accompanying the presentation of the *Annuaire du Bureau des Longitudes* for 1892.—On the number of roots common to several simultaneous equations, by M. Kronecker.—Another note on the same subject, by M. mile Picard.—On the glycolytic and saccharifying powers of the blood in hyperglycemic asphyxia, in phloridzic diabetes, and in the diabetes of man, and on the localization of the saccharifying ferment in the blood, by MM. R. Lépine and Barral.—Note on the diffraction effects produced by screens placed in front of photographic and ordinary object-glasses, by Prof. Pritchard. (See Our Astronomical Column.)—On conjugate systems with equal invariants, by M. G. Kœnigs.—On the theory of linear differential equations, by M. André Markoff.—Complement to one of Abel's problems, by M. Bougaieff.—On a new spectrometer (*réfractomètre*), by M. C. Féry. The principle upon which the instrument has been constructed consists in annulling, by a solid prism of variable angle and constant index of refraction, the deviation produced by a hollow prism having a constant small angle, and filled with the liquid whose refractive index is required. To realize these conditions, a prismatic-shaped cavity has been cut out of a double-convex lens in a plane perpendicular to the axis. This cavity is filled with the liquid under examination. And since, in a lens, the angle formed by the plane tangents to the surfaces of curvature is sensibly proportional to the distance from the optical centre, the angle of the lens considered as a prism can be varied by motion in a plane perpendicular to the axis. The amount of lateral motion necessary to bring about no deviation, when the lens containing a liquid is placed between a collimator and an observing telescope, furnishes the datum from which the index of refraction of the liquid can be calculated. The determinations that have been made indicate that the method is susceptible of high accuracy.—Researches on the application of measurements of rotatory power to the determination of combinations formed by sorbite in aqueous solution with acid sodium and ammonium molybdates, by M. D. Gernez.—Metallic borates, by M. H. Le Chatelier. The author has prepared, purified, and analyzed borates of magnesium, calcium, and zinc. He concludes that many of the complex borates previously described are in reality mixtures of comparatively simple borates with boric anhydride, and that the only types of borates of which the composition is sufficiently established are: B_2O_3, 3MO; B_2O_3, 2MO; B_2O_3, 1·5MO; and B_2O_3, MO.—On isomeric chromic sulphates, by M. A. Recoura.—On a silicon chlorosulphide, by M. A. Besson. The compound $Si_2Cl_2S_2$ has been obtained as a white solid, crystallizing in long needles melting at 74°, readily decomposing in the air, and acted on with violence by water.—A new crystallized copper phosphide, by M. Granger.—The solution of antimony chloride in saturated solutions of sodium chloride, by M. H. Causse.—On a double cyanide of copper and ammonium, by M. E. Fleurent.—Study of the thermal properties of bibasic organic acids: influence of the alcoholic function, by M. G. Massol.—Disodium glycol, by M. de Forcrand.—Action of dilute nitric acid on nononaphthene, by M. Konovaloff.—The formation of acetylene from bromoform, by M. P. Cazeneuve.—Action of phosphorus pentachloride on methylnaphthyl ketones: α and β naphthylacetylenes, by M. J. A. Leroy.—Observations on the subject of a note of MM. Arm. Gautier and R. Drouin, by MM. Th. Schlœsing, *fils*, and Em. Laurent.—On the formation of cordierite in the sedimentary rocks fused by the coal fires at Commentry (Allier), by M. A. Lacroix. An examination of some rock specimens from Commentry, where the underground combustion of coal has been going on for some time, shows that the most abundant mineral constituting the lavas formed (especially the ropy varieties) is cordierite. This mineral occurs in small crystals, which have not, however, been isolated and analyzed. It is accompanied by octahedric spinellids in connection with anorthite, and small, almost rectangular, microlites. The augite often exhibits the chrondritic structure of meteorites. The variation in the relative abundance of cordierite, anorthite, and augite, their very unequal dimensions in different specimens, and the relative abundance or rarity of the glass, give rise to numerous interesting petrographical varieties. Mallard's rhabdite has been easily recognized. The facts show that cordierite is easily formed by the action of heat on sedimentary rocks; indeed, it appears from the observations to be an habitual product of Carboniferous rocks modified by heat.—Functions of the pectiniform organ of scorpions, by MM. Charles Brongniart and Gaubert.—On the *régime* of the oceanic sardine in 1890, by M. Georges Pouchet.—On the presence of *Heterodera Schachtii* in cultures of carnations at Nice, by M. Joannes Chatin.—On a phtiriasis of fibrous copper, caused, in an infant of five months, by *Phtirius inguinalis*, by M. Trouessart.—Observations on the cellulosic membrane, by M. L. Mangin.—On the penetration of the violet filaments of the Rhizoctone fungus in the roots of beetroot and lucern-grass, by M. Ed. Prillieux.—On the assimilation of parasitic plants by chlorophyll, by M. Gaston Bonnier.—Earthquake of October 28, 1891, in Central Japan, by M. Wada.

BERLIN.

Physiological Society, December 11, 1891.—Prof. du Bois Reymond, President, in the chair.—Prof. Fritsch gave an account, illustrated by specimens and preparations, of the general result of his investigations on feebly electrical fishes, as far as these dealt with the structural arrangement of the electric organ, the nerves to the same, and the nerve centres.—Dr. C. Benda spoke about his recent researches on spermatogenesis, entering fully into the part played by the archoplasm in the development of spermatozoa.

Physical Society, December 18, 1891.—Prof. Kundt, President, in the chair.—Prof. Schwalbe recalled to the Society the loss it had sustained in the death of Dr. Ewald, one of its earliest and formerly most active members.—Dr. Budde gave a *résumé* of the work which has been done during the last ten years on supersaturated solutions, and an account of the present state of the question.—Dr. Paschen spoke on gravitational attraction and its measurement by Cavendish and his successors, dealing specially with the work of Boys, whose methods he explained and whose apparatus he exhibited to the Society.

AMSTERDAM.

Royal Academy of Sciences, December 19, 1891.—Prof. van de Sande Bakhuyzen in the chair.—Dr. Bakhuis Roozeboom treated of the influence of isomorphism on the behaviour of double salts during solution. He studied the isotherm of 15° for the saturated solutions possible with the system $FeCl_3$, NH_4Cl, and H_2O. When representing the numbers of mol. $FeCl_3$ and NH_4Cl pro 100 mol. H_2O in the solution, this isotherm consists of three branches. The first gives the solutions in equilibrum with solid $FeCl_3.6H_2O$, the second with the double salt $FeCl_3.2NH_4Cl.H_2O$, the third with mixed crystals containing from ± 8 per cent. $FeCl_3$ to zero. The three branches have two points of sharp intersection. In the first coexist the double salt with $FeCl_3.6H_2O$, in the second the double salt with mixed crystals containing the highest possible percentage of $FeCl_3$. These results confirm the rule that with systems of three bodies the composition of a solution is variable when only one solid phase lies at the bottom, but determined when there are two solid phases. The occurrence of mixed crystals besides double salts modifies the behaviour of the solution when one or other of the composing salts is added continuously.—Mr. J. A. C. Oudemans spoke on levels. He had had to try two levels of an altazimuth of the Sumatra triangulation, having each an air chamber at one of their ends; using a bubble not longer than one-third of the scale, he found the value of a division in the first and last third two or three times larger than in the middle, so that he inclined to reject the levels. But trying the same levels with long bubbles—for instance, of two-thirds of the scale—they proved much better, the inclination given by the level-trier being nearly proportional to the indication of the level, and the remainder of the irregularity being easily taken into account by a table. The necessity of making up, by experiment, a table of the inclination in a function of the level-reading, being once admitted, the judgment about a level ought to depend, not so much on the uniformity of the curvature, as on the constancy (the bubble remaining of the same length) of the reading, the inclination being the same; which property may easily be tested by the level-trier.

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